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EVOLUTIONISM

its POWER AND LIMITS

RAYMOND J. NOGAR, O.P.

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EVOLUTIONISM

EVOLUTION is a topic much discussed on almost every college and university campus. The subject usually stimulates as much lively discussion among students as it did in the celebrated courtroom debate between Clarence Darrow and William Jennings Bryan in the famous Scopes trial of 1925. But the question of the "fact of evolution" is much more than a conversation piece for student dorm-sessions; it is an important issue confronting scientists, philosophers and theologians, and it demands their highest quality of research and scholarship. Even among these scholars it seems to be no less controversial than among the spirited freshmen.

Statements made by the most competent scholars of contemporary evolutionary theory seem to be in open conflict about the "fact of evolution." At the Darwin Centennial Celebration held at the University of Chicago the statement was constantly reiterated that biologists "take the fact of evolution for granted as a necessary basis for interpreting the phenomena of life."[1] Dr. Sol Tax, chairman of the Convention, in his summary of the panel discussions extended the concept from biological evolution to universal evolution.

> But perhaps most of our schools still teach evolution, not as a fact, but as only one alternative among explanations of how the world has come to be what it is. No matter what gets done about our religious beliefs, this particular phenomenon must now come to an end. We cannot deal with the difficult problems of the world unless our education takes account of demonstrated empirical fact.[2]

Dr. E. C. Olson, in a paper submitted at the same convention, insisted that there is a silent segment of significant numbers among biologists and other scientists who feel that much of the fabric of evolutionary theory accepted by the majority today is actually undemonstrated or even false. He points out that the explanation of *how* the process of evolution has been accomplished must be dissociated from the statement *that* evolution has in some way taken place. Only then will many scientists accept the proposition "evolution is a fact."[3]

Further difficulty arises when the "fact of evolution" is discussed by philosophers and theologians. Pope Pius XII, referring to universal evolution says:

> Some imprudently and indiscreetly hold that evolution, which has not been fully proved even in the domain of natural sciences, explains the origin of all things, and audaciously support the monistic and pantheistic opinion that the world is in continual evolution.[4]

In reference to the origin of the human body in particular he continues:

> Some, however, highly transgress this liberty of discussion when they act as if the origin of the human body from preexisting and living matter were already completely certain and proved by facts which have been discovered up to now and reasoning on those facts.[5]

On the face of things, there seems to be fundamental differences of opinion about the fact of evolution among biologists themselves, as well as disagreement between biological sciences, philosophy and theology. It may be, however, that the apparent disagreement about the "fact of evolution" arises from a fundamental ambiguity in the terms of some of the statements. There cannot be true disagreement in a dialogue until there is fundamental agreement and clarity about the meaning of the terms used in the discussion. Minimal topical agreement must be had: men must agree to disagree.

The purpose of this study is not to choose sides in a debate, but to attempt to clarify the ambiguities which have generally arisen in discussions of evolution. To understand the meaning and significance of these controversial statements it will first be necessary to define the elements in terms agreeable to all. To discover the valid content and limitations of these statements it will be necessary to delineate carefully their context. Only in this way can the confusion and ambiguity, the gross overstatements and narrow misconceptions, the fanatic apologetics and passionate rebuttals about the "fact of evolution" be dissipated.

THE MEANING OF EVOLUTION

The proposition "evolution is no longer a theory, it is a fact" is valid or invalid depending on the significance assigned to two terms: "evolution" and "fact". If we disengage the series of events called evolution from any discussion about the *way* evolution might have taken place, we might begin with the definition set down by the Centennial Convention as our constant in the present discussion:

> Evolution is definable in general terms as a one-way, irreversible process in time, which during its course generates novelty, diversity, and higher levels of organization. It operates in all sectors of the phenomenal universe but has been most fully described and analyzed in the biological sector.[6]

The definition accepted by the Convention is not limited to organic evolution, but is stated broadly enough to include "all sectors of the phenomenal universe." It must be noted also that it is so broad as to allow much ambiguity when the question of the term "fact" is applied to it in specific sectors of the phenomenal universe.

THE ORDINARY MEANING OF "FACT"

The accepted meanings of the word "fact" fall into five categories: (1) a thing done; deed, specifically, an unlawful deed, crime; (2) that which has actual existence; an event; (3) the quality of being actual; actuality; as, the realm of fact as distinct from that of fancy; (4) the statement of a thing done or existing; as, his facts are false; loosely, the thing supposed (even though falsely) to be done or to exist; (5) Law: specifically in the plural; any of the circumstances or matters of a case as alleged; also, that which is of actual occurrence; reality as an event.[7] The range or meaning here also indicates the possibility of ambiguity, but a fact usually means some deed or event which is known to have actually taken place. Analogously and loosely the term is applied to events supposed or alleged to have taken place, even though the supposition may be unsupported.

In ordinary speech the term "fact" implies an element of certainty, or, at least, the removal of doubt about the actual existence of some event. A "fact" is supported either by evidence or by inferences from evidence, but in any case, until one can ascribe existence to a deed or a thing, the term "fact" is generally not ascribed. To the ordinary person, fact is contrasted to fiction, fancy, mere supposition, hypothesis, guesswork, inconclusive evidence and uncertain or doubtful inferences.

TECHNICAL MEANINGS OF "FACT"

When the student of language begins to investigate the special and even technical usage of terms in the sciences and the arts, he finds refined and special meanings, sometimes quite incomprehensible and seemingly contrary to popular usage. The term "fact" has not escaped analogous and even equivocal modification in its use by the sciences and the arts.[8] For example, in legal cases certainty is not required for adjudication. In the words of Hart and McNaughton:

> In a criminal case, guilt need not be found beyond all doubt. The trier of the fact must be satisfied of the defendant's guilt only "beyond a reasonable doubt." In a civil case, the facts are ordinarily to be found on the basis of "preponderance of evidence"; this phrase is generally defined as meaning simply "more likely than not."[9]

That evidence and inferences in criminal and civil law cases should have this quality of uncertainty about "facts" is widely known and rather expected. We would expect something quite different, however, when we consider the evidence and inferences proper to the "exact sciences" of physics and chemistry. At one time in the not too distant past, the meaning of fact in physical and natural sciences did seem to be quite clear.

> Observation is just opening one's eyes and looking. Facts are simply the things that happen; hard, sheer, plain and unvarnished.[10]

Without much adjustment, this formula is found in the classical text-books on the methodology, not only of physics and chemistry, but of the biological, anthropological, psychological and sociological sciences as well. One might suppose then that a "scientific fact" would be an event, or thing, or deed which could be immediately and certainly observed. So the classical methodologies of the nineteenth and early twentieth centuries seemed to view the use of the term "fact."

But with the rapid revision in the methodology of particle physics (micro-physics), due to the indirect techniques necessary to handle the data, many remarkable changes have taken place in the canonized terms of classical macro-physics, biology, and the human sciences. Classical meanings attached to such terms as *causality, fact, law, hypothesis, probability,* etc. ceased to correspond with the concepts introduced by the micro-physicist. On his level of research, the observation of facts, because of the indirect techniques employed, cannot be disengaged from the concepts, assumptions, constructs, analogies and extrapolations used to set up the experiment. The "thing" studied became a spatio-temporal measurement; its "properties" became a description of the processes by means of which these measurements are made.[11] Fact and inference, technique of observation, and the event or thing observed were so blended that the classical meanings were radically altered in the direction of subjective analogy. In the light of the methodology of micro-physics:

> Observations, evidence, facts; these notions, if drawn from the "catalogue sciences" of school and undergraduate text-books, will ill prepare one for understanding the foundations

> of particle theory. So too with the ideas of theory, hypothesis, law, causality and principle. In a growing research discipline, inquiry is directed not to rearranging old facts and explanations into more elegant formal patterns, but rather to the discovery of new patterns of explanation.[12]

The operational methods of micro-physics have not completely modified the usage of the term "fact" on the level of the macro- and the megalo-sciences, but biologists, chemists, psychologists, anthropologists, sociologists and even historians have not remained unaffected by this change in the fundamental meanings of the basic concepts of physics. For our purposes here, it suffices merely to mention this increasing tendency for technical scientific language to depart from the common acceptation of the term "fact."

THE "FACTS" OF PREHISTORY

Returning to the issue of the "fact of evolution," we are confronted with another problem—a question which is essentially an historical one, or, more properly, a problem of *prehistory*. Obviously, questions about the origins of life, the elements, the earth, the stars, the nebulae, etc. are problems of prehistory. Consequently, the evidence and inferences brought forward in support of these "facts" unwitnessed by human eyes will be the kind proper to the disciplines which study prehistory.[13]

In matters concerning the sciences of prehistory (paleontology, archaeology, etc.), two extremes must be avoided: (1) expecting more from the kind of evidence and inference than is reasonable, and (2) attributing greater stability and reliability to the evidence and inferences than is reasonable. In order to avoid these excesses, it is necessary to assess properly what kind of problem the prehistorian meets, and the power and limits of his methodology in seeking solutions. Perhaps we can best understand the problem of discovering "facts" and making "inferences" in prehistory by comparing its methods to those of the professional historian.

HISTORICAL METHOD

Scientific history differs from other sciences and arts in its subject-matter, its facts, its primary aim, its language, its theories and interpretations, its methods and its meaning.[14] Its subject-matter is the recorded past, more or less dramatized or put into order. The recorded past is a series of individual events, actions, persons, nonrecurring for the most part, seen in the context of a space-time continuum. The facts are individual, concrete, unrepeatable events made available by the witnesses who recorded them. The primary aim of history is to reconstruct the events in their individuality, thus resembling a literary narrative rather than a scientific treatise.

Historical method is a combination of scientific evidence and inference with imagination, insight, and empathy. History employs causal and even teleological explanations, shows trends and illuminates events, but is not causal in the strict scientific sense. The meaning of the series of contingent events and their patterns depends upon the theological or philosophical assumptions of the historian. Upon most of these statements, contemporary historians agree.[15]

We must pass over the debate among historians about the knotty problem concerning the certainty or probability of historical evidence and inference.[17] This we know, that the laws of observation and logic obtain in history as in every science, and that the degree of probability, or the attainment of certitude, depends upon the trustworthiness of the available witnesses. Obviously, since history cannot be repeated and therefore "tested out" like a scientific experiment, the element of conjecture mounts up in this discipline. "Historical facts" lie more in the realm of events which *probably happened,* than in the category of events which *certainly happened.* The reason is simply that the historical method depends so much upon indirect evidence, inferences which depend entirely upon the relative trustworthiness of the statements of the witnesses, as well as the teleological, philosophical and theological assumptions and interpretations of the historian.

If the element of uncertainty prevails in securing evidence and making inferences in *history,* how much more is this the condition of scientific *prehistory* which must draw conclusions without the aid of the statements of witnesses.

SCIENTIFIC PREHISTORY

In human prehistory (e.g. archaeology), what must take the place of written records and preserved technological phenomena is the mental artifact called the *model.* This is a human construction based upon extrapolation, interpolation and rational analogies to things known to us more directly and immediately. Simpson stresses the point that the paleontological record of fossil remains of the past eras of organic life must be read with two factors in mind: (1) the essential tool (in reading the record) is extrapolation from what we know in neo-biology and present geological formation, an extrapolation which has serious limitation and must be carefully regulated; and (2) the very nature of the materials makes it obvious that the record should not be read with a score of fundamental biases.[17]

A patient study of the methods[18] of geology, archaeology and paleontology manifests two significant points: (1) "facts" based upon evidence and inference proper to scientific prehistory are unique, and, in themselves, highly conjectural and logically tentative; and (2) the convergence of prehistoric "facts" with the evidence and inferences drawn from neo-science (biology, anthropology, etc.) yields an unexpected reasonable basis for a series of important convictions about what happened during these past eons of time. Scientific prehistory should neither be overstated nor be underrated in its ability to resolve some of the problems of origins.[19]

"FACT" AS A REASONABLE CONVICTION

Thus far we have seen that the term "fact" is used variously in the sciences depending upon the kind of evidence available, and that the question of origins must be judged in terms of the "facts" of prehistory which, while yielding a reasonable basis in support of evolution, are nonetheless conjectural and tentative.

For those who take the pains to qualify their conclusions with the appropriate caution, the assertion that "evolution is a fact" clearly refers to a "fact of prehistory", not of history, nor of physics, nor of chemistry, nor of biology, etc. Piggott, in a very illuminating paper at the Darwin Centennial states:

> What follows from this is, I think, of permanent importance and insufficiently recognized: the nature of the evidence dictates the nature of the inferences which can be properly drawn from it . . . I want to stress here that the past-as-known which is based on archaeological evidence is not, and cannot of its nature be, the same as the past-as-known based on evidence which involves the written record in lesser or greater degree.[20]

In 1951, the eminent geneticist T. Dobzhanski wrote:

> Evolutionists of the nineteenth century were interested primarily in demonstrating that evolution has actually taken place. They succeeded eminently well. Evolution *as an his-*

> *torical process* is established as thoroughly and completely as science can establish *facts of the past witnessed by no human eyes.*[21]

Indeed the scientific prehistorian might wonder that anyone would raise the question whether he meant by the "fact of evolution" that it was objectively certain and could not be otherwise. He would insist that his science produced proofs so highly probable that the unbiased, objective observer must be convinced by the convergence of disparate but mutually supporting evidence. No more, no less. *This is what a prehistoric fact means to the prehistorian.*

When this is appreciated any misunderstanding between the prehistorians' affirmation that "evolution is a fact" and the philosophers' or theologians' statement that "evolution has not been proved even in the domain of the natural sciences" can be resolved. In the sense of the prehistorian, evolution is a "fact" as opposed to a mere hypothesis which has not the documentation sufficient to remove doubt and generate the conviction described. Evolution is a "fact" as opposed to a theory among theories of reputation, as the "steady-state" theory is opposed to the "pulsating universe" theory in cosmology.[22] Evolution, as defined by Olson, abstracting from the various hypotheses concerning how the process took place, enjoys the status of having no other reasonable natural explanation of the converging evidence to oppose it with sufficient evidential support to produce high probability or conviction. Evolution is a "fact" as opposed to a low degree of probability. On certain levels, e.g. on the level of organic evolution, the degree of probability is high.

What the phrase "evolution is a fact" does *not* mean, however, is that it now enjoys the status of demonstration which generates the certitude of direct observation or inference which follows so necessarily from that observation that it could not be otherwise. This is an important distinction to the philosopher. For him not every "proof" generates the same degree of certitude or probability. While not denying the reasonable conviction of the prehistorian, the philosopher merely points out that the prehistorian's methodology by its very nature cannot yield the degree of certitude that can be obtained in other areas of natural science. Without disparaging the logical quality of the statement "evolution is a fact" it does remain *in the order of probability, not in the order of certainty.*

Thus it is readily seen how the statements at the Darwin Centennial, constantly using the phrase "fact of evolution," were not unequivocally in opposition to the statements made by some philosophers and theologians regarding the certitude of the "fact."

HUMANI GENERIS

Humani Generis asserts that evolution has not been fully proved even in the domain of natural sciences and that those transgress liberty of discussion who act as if the origin of the human body from pre-existing and living matter were already completely certain and proved by facts which have been discovered up to now and by reasoning on those facts. It is of capital importance to understand these statements of Pope Pius XII in the context, not of a biological treatise, but of a theological treatise. He was not concerned about biological or anthropological methodology; he was not writing a paper for the Darwin Centennial Celebration. He was writing a theological document, using the language proper to the readers to whom it was addressed, namely, the outstanding theologians and philosophers of the Catholic Church. He was writing primarily for those Catholics who were familiar with the logical distinctions between those arguments which generate certitude and those which conclude only to a degree of probability. The reason was evident. Theologians have to evaluate carefully the degree of probability of scientific propositions in order to place them properly in the context of another source of truth—Divine Revelation.

Pope Pius XII was not questioning the validity of the concepts of prehistory as synthetic models organizing much of organic or even cosmic science; he was not controverting the evolution of species or even the possible organic relationship of the human body to other primates. He was using traditional logical concepts of certitude, probability, rhetorical convictions, in order to show that many evolutionary propositions do not attain certitude but only a limited degree of probability and there are many elements of evolutionary teaching which are still seriously controverted—a fact which Olson and others took great pains to point out to the Convention. For these reasons, therefore, the "fact of evolution" could not be placed in opposition to matters of Divine Faith as a truth known to be demonstrated with certitude.

It is manifest from the context of *Humani Generis* what Pope Pius XII wished to do, namely, to call seriously into question whether the "fact of evolution" explains the existence of all things and supports the monistic and pantheistic opinion that the world is in continual evolution.[23] He by no means contradicts the assertions of Dobzhansky, Le Gros Clark, Olson and others that the objective observer, looking without bias at the converging evidence, must be convinced of the very high probability that evolution has taken place. He does not address himself to that problem; he merely advises professional caution. The proposition he does controvert is that the "fact of evolution" applies equally and unequivocally to the origin of all cosmic entities; the universe, the nebulae, the stars, the elements, life, diversity of organisms, man's body, his mind, culture and society, morals, religion, language and art.

THE "FACT OF EVOLUTION" APPLIED

Returning to the definition of evolution which states that it "operates in all sectors of the phenomenal universe," the questions raised by *Humani Generis* must be considered. Does the "fact of evolution" apply to "all sectors of the universe" in the same way? Are there some areas in which "fact of evolution" does not apply at all, or at least only in the loosest sense of the word "fact", that is, an unsupported allegation?

If the record be read carefully the Darwin Centennial papers manifestly showed the truth of Pope Pius XII's position, namely, that the phrase "fact of evolution" does not apply in the same way to many scientific disciplines, and to some areas, not at all.

THE PREHISTORIC FACT OF ORGANIC EVOLUTION

Whether there is presently sufficient converging evidence for the reasonable and unanimous conviction among scientists that "common descent (monophyletic descent) with modification" accounts for the variety of organic species, including man, on the earth was not even discussed at the Darwin Centennial Convention. As Simpson wrote in his *The Meaning of Evolution* (1949), the evidence is in and the case has been fairly adjudicated. Assuming two essential propositions: (1) that a *natural* explanation, consonant with what we know now in neo-biology about organic development, is available; and, (2) that extrapolation, analogy and indirect convergent proof be allowed where direct proof is unavailable; then, the accumulation of arguments found in any good modern text-book on evolution suffice to convince the unbiased and objective observer that evolution has, in fact, taken place.[24]

Indeed, the case for the prehistoric fact of organic evolution is a very good one. Biologists no longer question it. The basis for this assurance is the converging evidence for monophyletic descent with modification. Unless the reader realizes the full impact of each piece of converging evidence, he is quite likely to take a negative and dialectically critical view and reject the evidence as logically inconclusive. As a mere dialectician, he is prone to ask more of the evidence and inferences than possibly can be made available, and fail to appreciate how very convincing the evidence, taken together, really is. The following considerations constitute the essential elements of this converging evidence.

THE CONVERGING EVIDENCE

In the first place, the paleontological record needs a natural explanation consistent with neobiology. Reject this proposition and you place the question of origins outside the domain of natural science, and must invoke catastrophic theories, preternatural influences, divine interventions by miracles, etc. which would be not only bad science, but also bad natural philosophy and bad theology.[25] Scientific prehistory shows a series of origins and developments from the pre-Cambrian period over 500,000,000 years ago to the present which leaves no doubt among disinterested observers that there was a series of successive origins of plants and animals. Most of the species of plants and animals that we know today are quite recent in the fossil record, and good sequences of origins have been established by scientific prehistory. This series includes the fossil evidence for some structural development of *Homo sapiens*. The only available *natural* explanation which does not conflict with the natural processes manifest in geology and neo-biology is the evolutionary one, common descent with modification.

Within particular species, Ford's field work on the moth and the selective forces at work in modifying the species supports the concept of natural modification in species and varieties; Dobzhansky's work (and others) on *Drosophila* give convergent support to the theory of common descent with modification from the standpoint of mutation of genes and the survival of such mutation within the population.

On the generic level, the amazing series of freshwater mollusks *Pauludina* can be traced in a single 300 foot deposit: nine species with more and more complicated shells emerge from one smooth-shelled species. Equally significant is the same kind of evidence found in English chalk of the *Micraster* (sea urchin) series.

On the family level, the *Equidae* (horse) series elaborated by Marsh and Simpson is most striking. Twelve to fifteen genera of horses can be traced with convincing dialectic and fossil documentation from the Eocene period, 60 million years ago, to the present living genus, *Equus*. Similar studies, though not quite so convincing perhaps, have been made among the ammonites, camels, swine, crocodiles and fishes.[26]

Taken singly, any one series is established with the use of a scientific methodology which is vulnerable to the stringent rules of demonstrative logic. Yet, remembering the *singular nature* of the problem of origins and the only methods natural science has at its disposal, it is not *certain demonstrative proof* that we are after, but that *high degree of convergent probability* which produces conviction and removes all reasonable doubt.

With the paleontological record objectively before us, and the series of simpler forms to the more complex appearing in distinct periods of space and time, let us see how all the disciplines of neo-organic science contribute buttressing, yet divergent, arguments in support of common descent with modification. Again, limited space allows only a schematic summary. In bio-geography, the area which was so convincing to Darwin, we find biogeographical realms, discontinuous distribution and exological zones. Within the local areas, we find marvelous resemblance and adaptations to the particular environment. These singular conditions can best be explained by common descent with modification. How else can the distribution of distinct species of finches on the various islands of Galapagos be explained, species which so closely resemble the genera of finches on the South American mainland?

In taxonomy, the classification of plants and animals, a marvelously delicate hierarchical relationship is manifested, just what would be expected from common phylogenetic descent with modification. As Darwin had put it "the only known biological explanation for close similarity in nature (among organisms) is common descent."[27] This statement is not universally true, as more recent studies have shown,[28] but the argument is dialectically sound and weighty. Taxonomic relationship is best explained by common descent with modification.

A similar convergent argument is contributed from the morphological sciences, e.g. anatomy and physiology. A study of the organ systems of animals manifests a phyletic prototype which is varied from class to class, family to family, etc. These homologies and analogies are best explained by common descent with modification.

In embryology, the student finds that individuals of different species (e.g. the hog, calf, rabbit and man) pass through embryological stages which are almost identical, a fact which is best explained by common descent with modification.

From cytology and biochemistry, other arguments are advanced. For instance, protoplasm, blood, hormones and enzymes show properties which are remarkably similar in large groups of animals. This is best explained by common descent with modification.[29]

These basic observations and generalizations from the several departments of biology could be multiplied and detailed with endless documentation, but this summary must suffice to give the uninitiated reader some sense of the convergence of argument and the buttressing strength of the contribution of neo-biology to the general argument of organic prehistory. Again, close study of any fundamental textbook on evolution will guarantee two important insights: (1) the special kind of answer one must expect from a natural investigation of origins—its limits, if you will; and (2) within this context, the power of the argument, the high probability which the convergence of evidence generates among those who view the question of origins impartially.

As a member of the animal kingdom, the species *Homo sapiens* is included in the general arguments above. Physical anthropology has used the scientific methods of prehistory with almost uncanny effectiveness to produce a series of hominoid descent with modifications comparable to the best series among the other mammals. A classification of skulls and other fossilized parts (based upon several fundamental characteristics, which, taken together, comprise a total morphological pattern distinguishing the anthropoid ape skull from the hominoid type skull) reveals a graduated series rivaling that of *Equidae*. From *Australopithecus* (500,000-1,000,000 years ago) through *Pithecanthropus* (200,000-500,000) represented by Java and Pekin man, *Pre-Mousterian* (100,000-200,000) represented by Steinheim, Fontechevade and Swanscombe, *Early Mousterian* (50,000-100,000) represented by Mt. Carmel in Palestine and others in Europe, to *Late Mousterian and Modern Man* (about 50,000) represented by the Neanderthals on one branch and modern European man on the other, we find surprising fossil documentation of descent with modification of the human body.[30] To the physical anthropologist, the weakness lies not so much in this series of developments, but rather in the lack of fossils connecting *Australopithecus* with the fossil hominoids (great apes) of the Pliocene and Miocene eras. Le Gros Clark admits that mere extrapolation backwards in the absence of concrete fossil evidence is not a satisfactory procedure.[31] This apparent gap is disturbing, but not of such proportions as to shake the general conviction that *Homo sapiens* is biologically related to the rest of the animal kingdom in a natural continuum, even though much important evidence remains to be uncovered.[32] What the paleoanthropologist does have by way of documentation of the "fact of physical evolution" of man is very good.

THE FACT OF COSMIC EVOLUTION

In the Darwin Centennial Celebration papers, the question whether organic evolution is a fact was barely alluded to. It was taken for granted.[33] The issue of the Centennial was far more extensive in scope. The burden of the papers and the panel discussions was to show that the concept of evolution (and especially the neo-Darwinian interpretation) was valid in every major scientific discipline. The "fact of evolution", it was asserted, can and should be extended to the origin of mind, culture, life, the cosmos itself and all it contains. In this extension of evolutionary thought to the problem of origins in every field the Centennial papers provided expert commentaries of great value.

A careful analysis of the way the concept "fact of evolution" is used in the fields outside biology reveals *a fact of considerable importance.* The concept "fact of evolution", valid in the matter of organic origins and diversity as described above, becomes *equivocal* as it is applied to the origin of life, chemicals, stars, nebulae, mind, language, culture. Neither "fact" nor "evolution" retain the same meaning, and the evidence and inferences are of another kind, varying from discipline to discipline. In point of fact, there is great uncertainty that the concept "fact of evolution" is relevant in some areas of scientific study. This element of equivocation in terminology, in evidence and in inference, is often completely overlooked, and the degree of conviction generated in the biological sciences is by no means present to the same degree in some of the others areas of science.

This mutation in evolutionary concept as the observer goes from one field to the next is of greatest importance in evaluating the scientific dimensions of evolutionary theory. The problem is treated in detail elsewhere,[34] and can only be touched upon here by a few examples drawn from the Centennial papers.

THE ORIGIN OF LIFE

Applying the hypothesis of evolution to the origin of life, H. Caffon compared the status of the "fact of evolution" in biology to that of the natural origin of life from the inorganic (biochemical biopoesis). After admitting the conviction generated by convergence of evidence in biology, he states:

> The situation in respect to biopoesis is exactly the reverse. There is nice theory, but no shred of evidence, no single fact whatever, forces us to believe in it. What exists is only the scientists' wish not to admit a discontinuity in nature and not to assume a creative act forever beyond comprehension.[35]

The acceptance of the "fact of evolution" of life from non-life is based upon a conviction of an entirely different kind. The biologist and the biochemist look across a chasm which is filled only by a combination of imagination, extrapolation, human faith and a lively hope. This is not to disparage research in biopoesis, for out of this combination emerge working hypotheses with which the problem of bioposesis may one day be solved. But today the concept "fact of evolution" cannot be applied to the origin of life except in this *equivocal* sense. Evidence and proper inference is lacking at the present stage of investigation.[36]

THE ORIGIN OF ELEMENTS

When the concept "fact of evolution" is applied to the origin of chemical and physical elements, an even greater degree of *equivocation* on the terms "fact" and "evolution" is present. Smart,[37] Urey,[38] Fowler[39] and others are very guarded about the extremely hypothetical nature of the knowledge concerning the formation of the elements of our own system. Highly tentative backward extrapolation and reasoning from analogies with our present system of elements, coupled with many alternative theories, all enjoying some reputation, give another meaning to the phrase "fact of evolution" of the elements. As Shapley's paper on the evidence for inorganic evolution plainly manifests, the origin of the universe is hardly a scientific question at all, and the theories about the course of the universe's prehistory alternate between some one-way process and a cyclic process, a steady-state and an expanding universe depleting its energy.[40] The degree of conviction generated in these cosmic sciences is not so great as to rule out serious doubts and alternative explanations, and the meaning and status of the "fact of evolution" is equivocal.

CULTURAL EVOLUTION

Almost without exception, the Darwin Centennial panelists and those who submitted papers for *Evolution After Darwin* agreed that when the organic process introduced *Homo sapiens* upon the cosmic scene, the concept of the "fact of evolution" radically changed. Man may be terminal to a somatic-germinal evolution determined in part at least by the forces and mechanisms of selection and mutation which were operative in all the other higher animals, yet once the species *Homo sapiens* evolved, his evolution was no longer to be manifested merely in human body and gene complexes but rather in psychological potentialities.[41] Kroeber, Washburn, Howell, Hallowell, Critchley, Hilgard, Brosin, Piggott, Steward and Tax asserted in their professional contributions that the "fact of evolution" of man's mind, his language, his culture, his society, has a very limited and equivocal usage in comparison to its use in biology. Hallowell rejects, with Hilgard, the notion that there are no differences, except quantitative ones, between the learning of lower animals and man,[42] and Steward goes so far as to say:

> This paper is largely an admission of the general uncertainty now surrounding the concept of cultural evolution . . . In the physical and biological universes, evolution implies change which can be formulated in principles that

> operate at all times and places, although the particular principles of biological evolution differ from those of the physical realm. Expectably, or at least by analogy, then, cultural evolution should contain its own distinctive principles, which also underlie cultural change. *By this criterion, no one has yet demonstrated cultural evolution.* (Italics added.)[43]

These papers on cultural anthropology, archaeology, psychology and language not only show this radical change in the concept of evolution as it is applied to man, but they even show a strong tendency to ignore the concept of man's prehistory and concentrate upon man as he is now known to be the fashioner of his own future. Scientifically, man is best known, not in what he was in his prehistory, but in what he presently is and does. The "fact of man's evolution" is a concept which is most equivocal; it is a concept which seems to becoming obsolete in the sciences of human behavior and activity.[44]

THE FACT OF EVOLUTION IN SUMMARY

When we hear or read the statement that evolution is now no longer a theory but a fact, and should be taught as such, a healthy response to the statement should include neither the panic of complete and irrational skepticism, nor the acquiescence of immature and uncritical acceptance without serious qualification. We have seen that "fact" can mean a high degree of probability in prehistoric organic evolution; that the question of the origin of life from the inorganic is a valuable research hypothesis but no single fact yet "forces us to believe in it"[45]; that the question of the origin of elements even in our own system is extremely hypothetical; that the origin of the universe is hardly a scientific question at all; that even the term "evolution" must take a completely different meaning when applied to psycho-social man, his language, laws, culture, morals, art and religion. Thus one would have to be incredibly naive to accept literally the statement at the Darwin Centennial Celebration made to science teachers concerning the "fact of evolution":

> Properly taught, the knowledge which our students gain should produce in them a sense of the universality of evolutionary processes, from the prebiological molecular level through the pre-human world to man with his physical, mental, and sociocultural development, thus integrating the physical, biological, and social sciences, and, through history, the humanities.[46]

Careful delineation of the wide variety of meaning attached to the concept "fact of evolution" gives us a well focused view of the ambiguities and impertinances within such an over-simplified generalization. Proper distinctions make clear the power and the limits of evolutionary theory. The theory is a very complicated combination of univocal, analogous and equivocal statements, especially when an attempt is made to apply it to every scientific area of study. Some of these statements are strongly supported by evidence and securely drawn inferences; others are hopeful hypotheses and arbitrary assertions.

EVOLUTIONISM

As long as the "fact of evolution" is understood in its wide variety of equivocal senses, variously substantiated with that degree of probability presently afforded by the methodology used in each scientific discipline, the true value of the diachronic concept can be seen. Not only does a process of evolution add a dynamic space-time dimension to our understanding of the cosmos, but the evolutionary theory also provides a concept of synthesis for many disparate scientific approaches. Beckner observes:

> Evolution theory is of philosophical interest because of the way it integrates principles of the most diverse sorts, but, in addition, it is of interest because here we find the most diverse patterns of concept formation and explanation unified in a single theory.[47]

For many scientists and observers, this quality of unifying the work of many sciences, of integrating the explanations and approaches of diverse disciplines, is the outstanding contribution of evolutionary theory. But the very crucial question is raised by Beckner, and others at the Darwin Convention, whether, in fact, evolutionary theory provides an integration by way of a *constructural model* (or series of models) which is able to embrace the research of many sciences, or whether it provides *universal* laws, like Newton's laws of motion, the laws of conservation of mass and energy, the laws of thermodynamics. Mental constructs are universalized only in the imagination; universal laws are causal and necessitate the events of which they are causal. If there is a universal cosmic law of evolution (or laws), then it can be turned into an ultimate philosophical principle of the origins of cosmic entities, as some assert. If there is no universal cosmic law of evolution demonstrated by science, then no such philosophical generalizations are valid and the "fact of evolution", so far as a synthetic principle is concerned, remains a very useful construct but is non-causal, as others assert. The answer to this question is vital, *for it determines whether philosophies or ideologies*[48] *of evolutionism have bases which are scientifically established in the laws of nature.*

ARE THERE LAWS OF EVOLUTION?

If we can model our discussion of natural laws upon the methods of physics, the science which has for several centuries set the pace for methodological procedure, three closely interrelated tasks must be performed in establishing a body of knowledge (1) isolate the phenomena to be studied; (2) describe unambiguously what is happening; and (3) discern some specific permanence in the flux of events under observation. By this process, for example, the laws of conservation were formulated.[49]

We have seen how equivity enters into the very texture of evolutionary theory at every level of the "fact". Consequently, in this difficult question of prehistory and origins, there is a special and sometimes insurmountable difficulty in knowing whether the first two conditions above are satisfied. Isolating facts of prehistory and describing them unambiguously is, by the very nature of the problem, a large order. Assuming the most complete and reliable analyses of phylogenies, however, can we discern some specific permanence in the flux of events under observation?

B. Rensch takes up the problem of the "laws of evolution" in his paper for the Centennial Convention, and the question of the direction of evolution was fully discussed.[50] At first sight, it seems that in the flow of evolutionary events many laws can be formulated: (1) the law of increasing complexity; (2) the law of progressive speciation of phyletic branches; (3) the law of increasing size; (4) the law of migrations; (5) the law of adaptive radiation; (6) the law of irreversibility (Dollo's law); (7) the law of evolutionary continuity, etc.[51] Rensch lists sixty different rules which seem to have the quality of regularity, and he admits that they can be multiplied indefinitely.[52] But the curious fact about these "laws of evolution" is that *they have no universal character.* They are verified in limited areas only and admit of many exceptions. For this reason, biologists prefer to call them "rules" and "trends" rather than laws.[53]

More importantly, *the rules or trends are not attributes of evolutionary process, but are restrictive limitations on the process imposed by the existing fundamental laws of neo-science.* As Rensch points out:

> The large number of general rules quoted may be sufficient to show that, in spite of primary undirectedness, evolutionary alterations occur in forced directions to a large degree. *After all, every generalization in the field of biology means a restriction of evolutionary possibilities.* (Italics added)[54]

Dobzhansky confirms this observation that evolutionary pattern, though showing trends, is historical only, and nothing in the known history of life on earth compels one to believe that the evolution of organisms is predetermined to change in one direction only.[55] All the discussants at the Convention agreed that evolutionary process is unique, non-recurrent and irreversible, even though "trends" can be detected which show that the process is non-random. The course of evolution shows, generally, three stages: diversification, transformation and stabilization. But the process itself cannot be predicted, is unique and contingent, cannot be reversed (by which laws of nature are formulated) and is, by its very nature, *historical.*[56]

The upshot of this analysis is of capital importance. The laws of nature, which are formulated in the neo-sciences about the universe as we now

It is crucial to evolutionary analysis to detect the steps which are taken in the mental process by which what is known about prehistory can be gradually universalized into a philosophical principle of cosmic development without even noticing the illegitimate inference. In a restricted sense, evolution can be called a fact, but we must have a care for equivocation. In no sense is evolution a law of the cosmos; it cannot be so generalized. Here the false step is taken:

> For, where comparative anatomy offers only probability, paleontology brings certitude. Paleontology becomes, because of the breadth of its conclusions, a truly philosophical science.[59]

By some giant mutation of insight, science demonstrates that the historical process is immanently necessitated by the physical properties of the elements to produce increasing complexities, and that is simply all there is to the process. What began as scientific prehistory has suddenly become a life-philosophy of historicism, and its basis is "a necessary inference from science itself". A biological theory has become a monistic, mechanistic, historicist, life-philosophy of the cosmos by an illogical leap that remains to most observers completely undetected. Huxley finds it easy to draw this conclusion from the scientific finding of prehistory:

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The upshot of this analysis is of capital importance. The laws of nature, which are formulated in the neo-sciences about the universe as we now know it, are truly universalized; they are the laws of permanence, typical and verifiable by repetition and reversibility. The *rules* of evolutionary process, on the other hand, are contingent, non-reversible, unpredictable and bear the stamp of restriction based upon the natural laws of neo-science, the laws of permanence. *Strictly speaking, then, there is no universal law of evolution: there is only historical (prehistorical) process.*

PHILOSOPHIES OF EVOLUTIONISM

The importance of this last point cannot be overestimated. It is precisely at this major point that evolutionary theory provides an illegitimate extrapolation, often quite surreptitious, from a partially documented and very useful model called the "fact of evolution" into the realm of philosophy or ideology based upon an undocumented and thoroughly controverted "law of evolution". *The supposition of a universal, causal, cosmic law of evolution is not a valid inference from any known series of natural facts or laws established by science.*

It is absolutely necessary to disengage philosophies based upon this false supposition from scientific evolution in order to clear the air of many ambiguities which impede not only the educated person's understanding of evolution, but also discussions related to science, philosophy and theology. It is often wrongly thought, for instance, that the theological document *Humani Generis* quoted above is an unenlightened veto of the biological "fact of evolution". A close reading, however, will show that Pope Pius XII was repudiating, rather, the philosophies of evolutionism, whether they be mechanistic and monistic, or dialectical materialism, or some life-philosophies of historicism and existentialism.[57] Without denying a single piece of scientific evidence or a single legitimate inference, and even encouraging the useful research into origins of all cosmic entities, including man's body, he was denying that there is a shred of evidence from the natural sciences to prove that evolution is a cosmic law that explains the origin of all things, a law which repudiates all that is absolute, firm and immutable and gives values only to events and their history.[58]

Unfortunately, there are many scientists, as well as philosophers and theologians, who fail to draw the line between their scientific foundations which are firmly supported by evidence and their philosophical, or, more generally, ideological speculations. At one moment, they speak about biological or anthropological or cosmic evolution, and suddenly, without warning—and perhaps without knowing it themselves—they universalize evolutionary theory into a causal cosmic law and begin to draw philosophical conclusions about the universe in which we live. To the observer untrained in the logical arts, evolutionism, historicism, existentialism, mechanistic or even dialectical materialism may seem to be the necessary consequences of contemporary "evolutionary fact."

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> All reality is in a perfectly proper sense evolution, and its essential features are to be

> sought not in the analysis of static structures or reversible changes but through the study of the irrevocable patterns of evolutionary transformations.[60]

Philosophies of evolutionism, and they are as old as Heraclitus, are distinct from scientific evolutionary theory, and they take various shapes and meanings depending upon their primary assumptions. After Darwin, however, the various ideologies began to be framed in the context of evolutionary science, and the names Spencer, Marx, Bergson, Le Roy, Dilthey and Jaspers come to mind as representing some expression of a philosophy of evolutionism.[61] It is, in a limited sense, true to say that evolutionism, historicism and existentialism are fundamentally identical expressions on different levels of being: cosmic evolution, evolutionism; mankind's evolution, historicism; personal evolution, existentialism. The emergence of ideological expressions of evolutionism from the scientific study of origins and prehistory, the oustanding feature of American evolutionary thought in the last decade (crowned by Darwin Centennial in 1959), results from two dangerous tendencies in scientific thought.

FUNDAMENTAL ERRORS

The first of these is the unrestricted and uncritical use of the *scientific device of extrapolation.* At the convention, Olson warned against its dangers.[62] Simpson declared its limitations.[63]

Piggott is severely critical of every form of extrapolation, whether it be interpolation, interpretation, analogy or any other form of filling in the gaps of our knowledge with "postulates which fulfill an emotional need."[64] Case, Le Gros Clark, Gaffron and many others have tried to make explicit the limits of this necessary device of scientific prehistory.[65] But there is no doubt that what often appears in text-books and the more popular expressions of current thought on origins is far from critical.[66] The fanciful and unlimited use of extrapolation does much to gloss over the highly tentative nature of evolutionary trends, and, what is worse, seems to give a universal status to the "fact of evolution," whereas, in point of fact, there is no such cosmic law. This first error, the illegitimate use of extrapolation, can be corrected by caution in applying the device and, above all, by explicating its use so that the basis for inferences can be seen clearly.

The second error is more deep-seated, both theoretically and practically. It is what Maritain calls *the gnosticism of history.*[67] As the discussants at the Darwin Convention admitted, the prehistoric process which has been scientifically recorded and is called "the fact of evolution" is essentially *in the genus of history.* It is not science in the sense of the tested knowledge of reversible natural processes. As Simpson put it:

> That evolution is irreversible is a special case of the fact that history does not repeat itself. The fossil record and the evolutionary se-

> quences that it illustrates are historical in nature, and history does not repeat itself.[68]

Historians reproach the philosophy of history with four capital sins, accusations which throw light upon the fallacious extension of authentic scientific evolution to a philosophy of evolutionism. H. Marrou expresses the indictment this way:

> First, its almost inevitably oversimplified, arbitrary and wanton approach in regard to the choice of materials, the historical value of which is assumed for the sake of the cause; secondly, its self-deceptive ambition to get at an *a priori* explanation of the course of human history; thirdly, its self-deceptive ambition to get at an *all-inclusive* explanation of the meaning of human history; and fourthly, its self-deceptive ambition to get at a so-called *scientific* explanation of history, the word "scientific" being used here in this quite peculiar sense, which can be traced back to the sciences of nature, that with such an explanation our thought enjoys a kind of intellectual mastery over the subject-matter.[69]

This rather vehement reproach can, more quietly, be applied to the philosophies of evolutionism. 1) Evolution is an historical process, and, as such, it can have no *a priori* explanation; to assume one and then arrange materials to document it would be false to good scientific method. Simpson admits that the record cannot be read without bias, but bias must be reduced to a reasonable and defensible minimum.[70] 2) Since no true law of evolution is discernable, evolution cannot have an all-inclusive explanation written into its own process to be divined by analysis or arbitrary intuition. 3) Evolution is an irreversible process and therefore cannot be reconstructed according to necessitating laws. 4) Since evolutionary process can neither be its own explanation nor reconstructed according to necessitating laws, *scientific evolution cannot be a sufficient basis for any philosophy of evolutionism.*

Those who see evolution written into the "laws of nature" confuse two things: the *necessity of the laws of nature* and the *contingency of the historical events* which run their course quite naturally. The necessity proper to the laws do not make the events necessary. As Rensch observed, the laws of biology *restrict* evolutionary change; the laws of nature are structure and function to the most extraordinary degree.[71] The unique, irreversible historical process which is the sequence of contingent events we call evolution is not a law unto itself, necessitating all things that it elaborates. Evolution, like any history, can be characterized, interpreted or deciphered in a certain measure so as to reveal limited general *trends,* to use Simpson's term. But the history does not cause, nor necessitate, nor explain the natures or their laws. The cosmos is not merely its history; mankind is not merely its history; a person is not merely his biography. The cosmos and its natures have histories; mankind has a history; a person has a biography.[72]

Since the "fact of evolution" can never be more than a partially decipherable series of contingent events, it can never be universalized into a philosophical principle giving ultimate insight and interpretation of the cosmos in which we live or of our personal being by which we live. Philosophies of evolutionism, or, better, ideologies of evolutionism, may *appear* to be valid inferences from scientific evolution, but, upon close inspection the appearance is an illusions.

CONCLUSION: THE RHETORIC OF EVOLUTIONISM

By its rhetorical excesses, false philosophy of evolutionism can readily be detected. Huxley sounds the dominant note of the final phase of evolutionary thinking in America, especially prevalent during the past decade. Taking the "fact of evolution" beyond extrapolation and even beyond the mere philosophy of evolutionism, he gives a scientific theory the qualities of a faith with a prophetic *mystique*. This is no longer science or philosophy; it is a rhetorical formulation of evolutionism into an easily recognizable personal apologetic. Huxley proclaimed this "new evolutionary vision" in his Convocation address at the Darwin Centennial Celebration:

> In the evolutionary pattern of thought there is no longer either need or room for the supernatural. The earth was not created; it evolved. So did all the animals and plants that inhabit it, including our human selves, mind and soul as well as brain and body. So did religion.

> Religions are organs of psychosocial man concerned with human destiny and with experiences of sacredness and transcendence. In their evolution, some (but by no means all) have given birth to the concept of gods as supernatural beings . . . they are destined to disappear in competition with other, truer and more embracing thought organizations.[73]

To him, scientific evolution not only necessitates a new philosophy, it inaugurates a new prophetic vision, a new religious hypothesis to replace both the old hypotheses of supernaturalism and materialism (Marxian Communism). He develops his thought:

> I submit that the discoveries of physiology, general biology and psychology not only make possible, but necessitate, a naturalistic hypothesis (for religion), in which there is no room for the supernatural, and the spiritual forces at work in the cosmos are seen as a part of nature just as much as the material forces. What is more, these spiritual forces are one particular product of mental activity in the broad sense, and mental activity in general is seen to have increased the intensity and importance during the course of cosmic time. Our basic hypothesis is thus not merely naturalistic as opposed to supernaturalist, but monistic as opposed to dualistic, and evolutionary as opposed to static.[77]

One cannot read the proposal of a new faith called "evolutionary humanism" in Huxley's *Religion Without Revelation* without sensing strongly the rhetorical attributes which have accrued to a once scientific dimension of the "fact of evolution." Huxley's extention of evolutionary thinking to the position of a vision of the meaning of all reality is serious because it is done *in the name of science.* Yet this highly ideological and personalized explanation of the universe by cosmic history is filled with obvious gloss of analogy, metaphor and equivocation. It is extremely subjective, and, in the religious sense, apologetical. Time is the synthetic factor and the whole burden of his evolutionary philosophy is rhetorically aimed at commanding the conviction of the reader in the name and by the authority of science.

It should not be thought that the rhetorical philosophies of evolutionism are confined to the exponents of atheistic humanism (Huxley) or atheistic materialism (Marxists). They take many forms, one of which is found in the writings of those who claim that the "fact of evolution" necessitates a diametrically opposed religious hypothesis, namely, a revealed supernatural religion (Fr. Teilhard de Chardin). The starting point for the philosophy of evolutionism is ever the same:

> Is evolution a theory, a system or a hypothesis? It is much more: it is a general condition to which all theories, all hypotheses, all systems must bow and which they must satisfy henceforward if they are to be thinkable and true. Evolution is a light illuminating all facts, a curve that all lines must follow.[75]

The vision which follows in *The Phenomenon of Man* is quite different in what it prophesies from that of Huxley, for, as the assumptions are modified, the prehistory of the cosmos tells a different story. One story ends with an immanent god, man himself; the other ends with a transcendent God, the God of the Christian revelation.[76] But the basic rules according to which both accounts are fashioned are identical.

Whether the suppositions be supernaturally revealed truths, assumptions of monistic materialism, dialectical materialism or humanism, the first step is the elevation of the "fact of evolution" to the status of law, a necessary series of scientifically demonstrated events. The next step is to elevate the "law of evolution" to the level of a narrative world-view to which everything else must bow and in the light of which everything else must be understood. The third step is to personalize this new world-view with a highly personalized rhetoric of conviction.

In its final stages, the philosophy of evolutionism is an essentially personalistic, unverifiable intuition, rhetorically involved in ideological feeling and emotion, using a life-self-cosmos narration as the key to the meaning of reality.

The rhetoric conclusion of evolutionism usually can be distinguished from mere philosophy of evolutionism by the visionary language of the synthesis. The philosophy of evolutionism can be distinguished from the scientific "fact of evolution" by its illegitimate extrapolation and claim to universalization. The high probability of the "fact of organic evolution" can be distinguished from the lesser probability of the largely hypothetical "fact of evolution" in other natural sciences. The value of the "hypothetical fact of evolution" in some natural sciences can be distinguished from the "alleged fact of evolution" of mind, culture and religion. Thus disengaged, the fact of evolution can rightly be assessed as one of the most significant developments of modern science.[77]

NOTES

[1] *Evolution After Darwin,* edited by Sol Tax (Chicago, 1960,) III, 107. This three-volume work contains the University of Chicago Centennial papers and discussions and will be used as a constant reference. Hereafter, the work will be signified by the initials EAD.

[2] *Ibid.,* p. 247.

[3] *Ibid.,* p. 527.

[4] Cf. translation of the Encyclical Letter *Humani Generis* prepared by The Paulist Press, New York, 1950, p. 6. As a theologian Pius XII is primarily concerned with the monism and pantheism of some evolutionists, not with scientific evolution as such.

[5] *Ibid.,* p. 19. Note the temporal quality of this statement. In 1950, anthropological evolution had made little impression upon many areas of the philosophical and theological world. With the great advances of scriptural scholarship, and the new discoveries in human paleontology and genetics, the attention of theologians to questions of origins has increased considerably. Pope Pius' encouragement to scientists and theologians to mutual study of this question had resulted in important clarifications. In 1964, the case for human bodily evolution is much stronger, both biologically and theologically. Cf. R. J. Nogar O.P., *The Wisdom of Evolution* (Doubleday, 1964).

[6] EAD, III, 107. This definition was agreed upon by Huxley, Emerson, Axelrod, Dobzhansky, Ford, Mayr, Nicholson, Olson, Prosser, Stebbins, Wright, and presumably, by all other members of the Convention.

[7] *Webster's New Collegiate Dictionary,* 2nd ed. (Springfield, Mass., 1953).

[8] Cf. *Evidence and Inference,* ed. by D. Lerner (Glencoe, Ill., 1958).

[9] *Ibid.,* p. 53.

[10] E. Mach's words as quoted in N. R. Hanson, *Patterns of Discovery,* (Cambridge, 1958), p. 31.

[11] F. Renoirte, *Cosmology* (New York, 1960) p. 118.

[12] N. R. Hanson, *op. cit.,* pp. 1-2.

[13] The neo-sciences (e.g. neo-biology) offer butressing arguments for some of the prehistorical inferences (see p. 18), but the kind of evidence and inference which constitute the principal argument of evolutionary process is determined and limited by the very nature of the problem of prehistory.

[14] Cf. *The Philosophy of History in our Time,* ed. by H. Meyerhoff (New York, 1959) pp. 18-22.

[15] *Ibid.*

[16] R. G. Collingwood, *The Idea of History* (New York, 1957) p. 261.

[17] EAD, I, 129-34

[18] A good introduction to the methods of prehistory can be found in G. G. Simpson, *Life of the Past* (New Haven, 1953) and J. R. Beerbower, *Search for the Past* (Englewood Cliffs, N. J., 1960).

[19] The tendency to underrate scientific prehistory is a limitation of works such as G. H. Duggan, S. M., *Evolution and Philosophy* (Wellington, New Zealand, 1959).

[20] EAD, II, 87.

[21] *Genetics and the Origin of Species,* 3rd. ed. (New York, 1951) p. 11.

[22] EAD, I, 32-33.

[23] *Humani Generis,* ed. cit., p. 6.

[24] *The Meaning of Evolution* (New Haven, 1949) pp. 4-5.

[25] The natural philosopher would abhor a jumbled, disorderly concourse of unrelated natural events as totally out of keeping with natural laws. *Natura non facit saltus.* The theologian would abhor the thought of God specially and immediately creating, for example, distinct species of finches for each of the several Galapagos Islands at different times (multiply this miraculous intervention by the hundreds of thousands!) for it goes directly contrary to the theological axiom that God ordinarily orders all things wisely through secondary causes.

[26] Cf. Dodson, *op. cit.,* and especially, the symposium *Genetics, Paleontology and Evolution,* ed. by Jepson, Mayr and Simpson (Princeton, 1949).

[27] *The Origin of Species,* Chapter XIV (6th ed,; Modern Library), p. 320.

[28] The trend called "Parallel evolution" is described in Simpson's *Life of the Past,* pp. 127ff.

[29] See Dodson, *op. cit.,* for full treatment of these arguments.

[30] W. E. Le Gros Clark, *The Fossil Evidence for Human Evolution* (Chicago, 1955).

[31] *Ibid.,* p. 163.

[32] New evidence from the rich fields of fossils in Africa, for example, is constantly filling in the picture of prehistory. Dr. L. B. S. Leakey's discovery of *Zinjanthropus boisei* an important large Australopithecine in the late 50's and recently his discovery of *Homo habilis* in the same gorge are excellent examples of what we can expect in the future. New finds and dating techniques clarify the prehistory of man, but the general evolutionary sequence remains.

[33] EAD, III, 107.

[34] R. J. Nogar, O.P., "Evolution: Its Scientific and Philosophical Dimensions," *St. John's University Studies,* ed. Vincent E. Smith (Jamaica, N.Y., 1961) Series 3.

[35] EAD, I, 45.

[36] However, studies on the origin of life are proceeding on a very rapid and exciting scale. Microbiology, the study of genetic materials, DNA and RNA, the use of models like that of Eatson-Crick, and the marvelous experimentation on the problem of biopoesis give promise for a natural solution of the cosmic origin of life.

[37] *The Origin of the Earth,* Chapter 10 (Cambridge, Eng., 1951).

[38] *The Planets: Their Origin and Development* (New Haven, 1952) p. 11.

[39] See the analysis of scientific cosmology in M.K. Munitz, *Space, Time and Creation* (Glencoe, Ill., 1957).

[40] EAD, I, 33.

[41] For example, Huxley, EAD, I, 19; Tax, EAD, III, 280.

[42] EAD, II, 360.

[43] EAD, II, 182-83.

[44] EAD, II, 16

[45] EAD, I, 45.

[46] J. C. Mayfield, "Using Modern Knowledge to Teach Evolution in High Schools," Graduate School of Education Symposium of the Darwin Centennial Celebration. (Chicago, 1960) p. 7.

[47] M. Beckner, *The Biological Way of Thought* (New York, 1959) p. 160.

[48] For a useful distinction between a true philosophy and an ideology, see W. O. Martin, *Metaphysics and Ideology* (Milwaukee, 1959).

[49] G. Holton, *Introduction to Concepts and Theories in Physical Science* (Cambridge, 1952) p. 278.

[50] "The Laws of Evolution," EAD, I, 95-116.

[51] R. Collin, *Evolution* (New York, 1959) p. 55.

[52] EAD, I, 110.

[53] Simpson, EAD, 1, 167; Collin, *loc.cit.*

[54] EAD, I, 111.

[55] EAD, I, 405.

[56] G. G. Simpson, *The Major Features of Evolution* (New York, 1953) p. 312.

[57] *Humani Generis*, pp. 6-7.

[58] *Ibid.*,

[59] M. Vandel, quoted by Msgr. B. de Solages, "Christianity and Evolution," translated by H. Blair for *Cross Currents* from the *Bulletin de Litterature Ecclesiastique*, no. 4, 1947.

[60] Review of *Life of the Past* by G. G. Simpson, *Scientific American*, CLXXXIX (1953), 88.

[61] The interrelationship of these ideologies is clearly traced in I. M. Bochenski, *Contemporary European Philosophy* (Berkley, 1957).

[62] EAD, I, 532.

[63] EAD, I, 121.

[64] EAD, II, 92.

[65] E. C. Case, *op. cit.;* Le Gros Clark, *The Fossil Evidence for Human Evolution, loc. cit.;* Goffron, EAD, I, pp. 44-50.

[66] Compare with the above, for example, the article "Now Life Began," by E. A. Evans Jr. in *The Saturday Evening Post*, Nov. 26, 1960, pp. 25ff.

[67] *On the Philosophy of History*, ed. J. W. Evans (New York, 1957) p. 31.

[68] *Major Features of Evolution*, p. 312.

[69] Quoted in Maritain, *op. cit.*, p. 30.

[70] EAD, I, 121.

[71] EAD, I, 101.

[72] C. De Koninck, "The Nature of Man and His Historical Being," *Laval Theologique et Philosophique*, V (1949), 271.

[73] EAD, III, 252-53.

[74] *Religion Without Revelation* (New York, 1957) p. 187.

[75] T. de Chardin, S.J., *The Phenomenon of Man* (New York, 1959) p. 218.

[76] Indeed, this is no inconsiderable difference, and it was Fr. Teilhard's intention to work from the intuitive idealism of Bergson and French phenomenology of science to the Divine Alpha and Omega. The point here is that his evolutionism stems from assumptions, hypotheses or "intuitions" which lie outside the domain of scientific evolution, not from an inference from the scientific facts. In this method, his approach is not unlike that of Marx and Huxley.

[77] The need for a realistic philosophy of evolution, both to natural philosophy, metaphysics and to Christian theology cannot be underestimated. And the light which evolution sheds on the very nature and the future of man in this world is necessary for any valid world-view. Cf. R. J. Nogar O.P., *The Wisdom of Evolution* (New York: Doubleday and Co., Inc., 1964)

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